

Honors Thesis

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The Effect of Weaning on Pasture Consumption by Beef cows in a Four Week Period Following Weaning

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ABSTRACT: Forty crossbred Angus x Simmental cows were used to investigate the effect of weaning systems on pasture consumption by cows in the four-week period shortly after weaning. Cows and their calves were assigned to one of two treatments. Animals in the first treatment underwent a normal weaning protocol in which the calves remained with their dams and the dams were lactating throughout the duration of the study (NW). Animals on the second treatment underwent an early weaning protocol in which calves were weaned from their dams and the dams were not lactating throughout the study (EW). Distance walked was used as a proxy of forage consumption while grazing. Pedometers were attached to the cows two weeks after weaning and the total number of steps was recorded once a week for four weeks. Additionally the age of the dam, the daily mean temperature, daily total precipitation, and daily mean relative humidity were recorded. Data were analyzed as a repeated measures, mixed model using the MIXED procedure of SAS with the fixed effects of treatments, weeks, their interactions, and age of dams, and the random effect of dams nested within treatments, with a compound symmetry structure of the errors. Dams on the NW treatment walked on average 73,666 (± 1745) steps per week compared to 72,123 (± 2102) for the EW cows ($P=0.53$). There was a significant treatment by week interaction ($P<0.001$), as EW cows walked significantly less in week 2 (72,343 \pm 2753) than NW cows (78,609 \pm 2580). Age had a significant effect with first and second parity cows walking more (76,944 \pm 2998) than third or greater parity animals (64,795 \pm 1405). Although the effect of treatments was not significant across the four weeks, the significant effect during the second week suggests that a larger scale project with more experimental units and, hence, more statistical power should be performed. In addition, the validity of using pedometers as a proxy to feed consumption on pasture needs to be investigated. In addition, future research should be done over a longer period and the frequency of the measurements should be increased. The pedometers used resulted in approximately 37% of the potential measurements being lost, indicating that improvements in the devices are desired. In addition, future research should impose a better control (balance across treatment) for age of the dams. In summary, the pattern of feed consumption during the second week was affected by weaning. Thus suggesting that changes in grazing practices may be warranted, and also allowing producers to better manage their pastures and possibly maintain more cows per acre of land.

Introduction

Previous research has been conducted on the performance differences of early weaned and normal weaned calves. On average, early-weaned (**EW**) steers perform better than normal-weaned (**NW**) steers. Early weaned steers weigh more, gain faster, and are ready for slaughter 11 days before NW steers (Grimes and Turner, 1991). Average daily gains and weights at the time of normal weaning are higher for EW calves in a dry lot and EW calves on pasture than for NW calves, and no difference was found among breeds (Neville and McCormick 1981). Lower feed intake and better feed-conversions are found in EW calves and overall marbling score is improved when compared to NW steers (Myers et al, 1998).

Research has also been conducted that demonstrates the advantages of non-lactating dams (dams with EW calves) over lactating dams (dams with NW calves). When feeding mixed legume and fescue hay, and supplementing with soybean meal, EW cows consume 10 pounds or less than NW cows, yet weigh 26.3 pounds more than their NW counterparts (Grimes and Turner, 1991). Demonstrating similar results, EW dams are 25 kg heavier and their average daily gains .25 kg greater than NW cows (Neville and McCormick 1981). In addition, the average time from parturition to conception is 17.5 days less, and EW cows are 37.4 percent more likely to become pregnant when exposed than NW cows (Lusby et al., 1981).

Early weaning is currently used to alleviate stressed pastures and reduce feed costs for areas severely affected by drought (Lardy, 2002, Rossi et al, 2006). Some research has partially studied the effects of weaning systems on grazing habits of cows. In a study conducted by Harvey et al, it was found that a significantly higher yield of total digestible nutrients is harvested from non-lactating cow-lots as compared to other cow-lots when dietary salt levels are manipulated. However, it was found to be difficult to obtain a true estimate of the difference in pasture utilization obtained from early weaning systems (Harvey et al, 1975).

In addition to increased calf profitability, this research has established that EW cows have lower energy requirements than NW cows and will consume less feed when their diet is controlled (Knabel et al 1989). However, this does not necessarily mean non-lactating cows will consume less feed when grazing freely on pasture. The objective of this study was to determine if EW cows would consume less forage than NW cows when the cows control their own forage consumption while grazing on pasture. Since EW cows require fewer nutrients, the hypothesis was they would consume less forage than NW cows when grazing ad libitum on pasture.

The majority of cows in the United States are sustained year round by forage-based feeds. During the beginning of the pasture-growing season, cattle producers have a surplus of pasture and are able to harvest hay in anticipation of the upcoming dormant season. However, as the season continues, pasture growth slows, and what was once a surplus of pasture, quickly begins to decline. This decline in pasture production is typical of cool season grasses that provide high quality forage in early spring (Hopkins, 2000). In the growing seasons, cows are turned out on pasture to graze. However, the amount of forage produced during the low forage producing summer months will determine the number of cows that can be sustained on pasture. (See Figure 1 to observe pasture growth rate over time.)

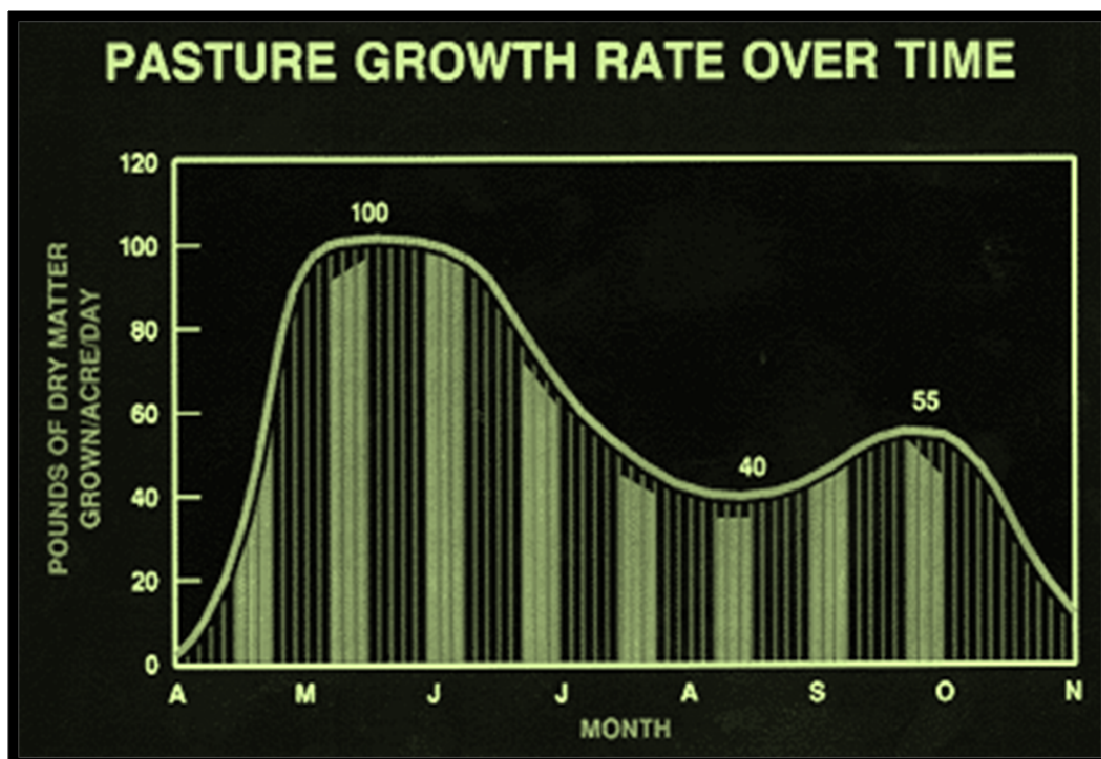


Figure 1: Pasture growth rate varies during each month of the year. Pasture growth during the lowest producing months is forty percent of the growth that occurs during the highest producing months. With exception of the dormant season, pasture growth is lowest during the summer months. Figure source: United States Department of Agriculture and Cornell University

The results of this study may change current production practices. If EW cows consume less forage when grazing on pasture than NW cows, it may become more desirable to use early weaning practices. This would allow producers to decrease the amount of forage consumed per

cow, potentially providing enough extra forage to add additional cows to the herd. On the other hand, with the increasing cost of land, producers could be able to maintain the same number of cows on less total acreage. In addition, feed costs are considered the most variable cost associated with livestock production (Peterson et al 1987). Although grass itself is not considered a feed cost, efficient pasture management can prevent separate supplemental feed costs, potentially increasing profitability.

Materials and Methods

Animals and Management

Forty spring calving crossbred Angus × Simmental cows and their calves were randomly selected from the cowherd at the Jackson branch of the Ohio Agricultural Research & Development Center located in Jackson, Ohio. During the year of the study, the majority of calves were born around March 4, 2007. An unrelated experiment occurring simultaneously required the early weaning of all heifer calves. Heifers were weaned from their dams on July 20, 2007 at approximately four months of age. Bull and steer calves remained with their dams until normal weaning. The sex of the progeny was not predetermined and the effect of milk production based on the sex of the calf is unknown, but believed to be negligible.

The cows and their calves were assigned to one of two treatments. In the first treatment, animals underwent a normal weaning protocol in which the calves remained with their dams and the dams were lactating throughout the duration of the study. Animals in the second treatment underwent an early weaning protocol in which calves were weaned from their dams and the dams were not lactating throughout the study. Both groups of cows remained in the same herd, had access to the same water source, pasture, and shade. Efforts were made to ensure that all forty cows were rebred and pregnant to eliminate increased walking due to behavioral estrus.

Pedometers

Distance walked was used as a proxy for forage consumption while grazing. Pedometers were utilized as a measurement of total number of steps taken for each individual animal in the study. Each pedometer was labeled with an individual identification code, indicating the treatment group and individual pedometer number. Pedometers were split into two sets, one for each of the treatments, and there was no interchange between pedometer sets during the study.

To prevent water damage, pedometers were wrapped in multiple layers of plastic. First pedometers were labeled and placed in a snack sized sealable bag and reinforced with duct tape. A later adjustment was made and nitrile gloves were used to increase water protection. An additional label was placed on the outer surface of the glove. Pedometers were securely attached to the subjects with duct tape, and once again labeled on the outer surface.

Pedometers have not previously been used to aid in measuring forage consumption in scientific research. However, pedometers used in another manner have proved to be valuable in research and in industry. In a study conducted at the University of Saskatchewan, pedometers were attached to newly weaned calves to determine stress levels. According to this study, calves that walked more were considered to be under greater stress (Haley et al, 2005, Haley et al, 2003). In addition, pedometers are currently used in the dairy industry as an indicator of several conditions including heat and illness. Although extremely useful for the aforementioned purposes, the use of pedometers as a proxy for forage consumption is a novel concept.

The possibility of variation in individual walking patterns jeopardizing the validity of the data was considered. Even though lactating cows require more water for milk production, they generally travel with the herd and make the same number of trips to the water source. Because cows are herd animals and usually travel as a group, other walking behavior should also be similar. Therefore, individual cow differences should be balanced across the entire study. Furthermore, visual observations were made in an attempt to assess individual cow and herd walking behavior.

Data Collection

Before collecting official data, the total number of steps taken for each animal was recorded for one six day trial period immediately following the weaning of calves in the early weaning treatment. Pedometers were placed on the cows on July 20 and removed on July 26. Further adjustments in pedometer preparation were made to further prevent water infiltration and nitrile gloves were introduced midway through application of pedometers for the first trial period. The trial period was immediately followed by four consecutive seven day observation periods. At the conclusion of one period, pedometers were removed using surgical scissors and they were immediately replaced with new pedometers for the following period. The periods

began on July 26, August 2, August 9, and August 16; and pedometers from the fourth observation week were removed on August 23.

In addition to the total number of steps taken per cow, the daily mean temperature, total precipitation, and daily mean relative humidity were recorded. The goal was to determine if these variables would have an impact on the weekly average of steps taken. In addition, visual observations were made to monitor grazing behavior of cows and to determine if original assumptions regarding individual and herd behavior were realized. However, due to the abnormally warm temperatures during the visual observation periods, cow activity was extremely limited.

Statistical Analysis

Data were analyzed as a repeated measures, mixed model using the MIXED procedure of SAS. The fixed effects of treatments, weeks, their interactions, and age of dams, and the random effect of dams were nested within treatments, with a compound symmetry structure of the errors. The analysis of daily mean temperature, total precipitation, and mean relative humidity was attempted, but because these data were tied to the week interaction, the effect of these variables could not be determined. The age of the dams was also analyzed to determine impact of age on the number of steps taken.

Results & Discussion

Unfortunately, waterproofing procedures were not sufficient until perfected midway through application of pedometers for the first observation period. Data was lost from pedometers lacking this improvement. In addition, a significant amount of data was lost during the third observation period. Upon further investigation, it was discovered that the internal pendulum inside many of the pedometers was pinched, preventing proper data collection. The cause of this is unknown. In order for pedometer readings to qualify for use in analysis, pedometers had to be in working order when they were removed after each observation period. This was not always the case and these potentially jeopardized readings were not included in analysis. In combination, these complications resulted in approximately 37% of the potential measurements being lost.

Throughout the duration of the study, NW cows walked on average 73,666 (± 1745) steps per week compared to 72,123 (± 2102) for the EW cows ($P=0.53$). Thus, throughout the entire

four-week period, there was no statistical difference between the two treatment groups. However, there was a significant treatment by week interaction ($P<0.001$), as NW cows walked significantly more in week 2 ($78,609 \pm 2580$) than EW cows ($72,343 \pm 2753$). This indicates that EW cows may consume less forage than NW cows when controlling their own feed consumption on pasture. Further research is warranted to further investigate this claim.

The differences observed in the other three weeks were not statistically significant. During the first week, NW dams walked $82,696 (\pm 2383)$ and EW dams walked $78,850 (\pm 2771)$. NW dams during the third week walked $66,963 (\pm 3558)$ and EW dams walked $71,877 (\pm 3384)$. Finally, during the fourth week NW dams walked on average $66,397 (\pm 2498)$ while EW dams walked $65,411 (\pm 2596)$. The lack of statistically significant results during these three weeks and in the study in general, could be due to the relatively small sample size and limited number of observations. (See Table 1 for weekly and overall average steps walked by treatment group.)

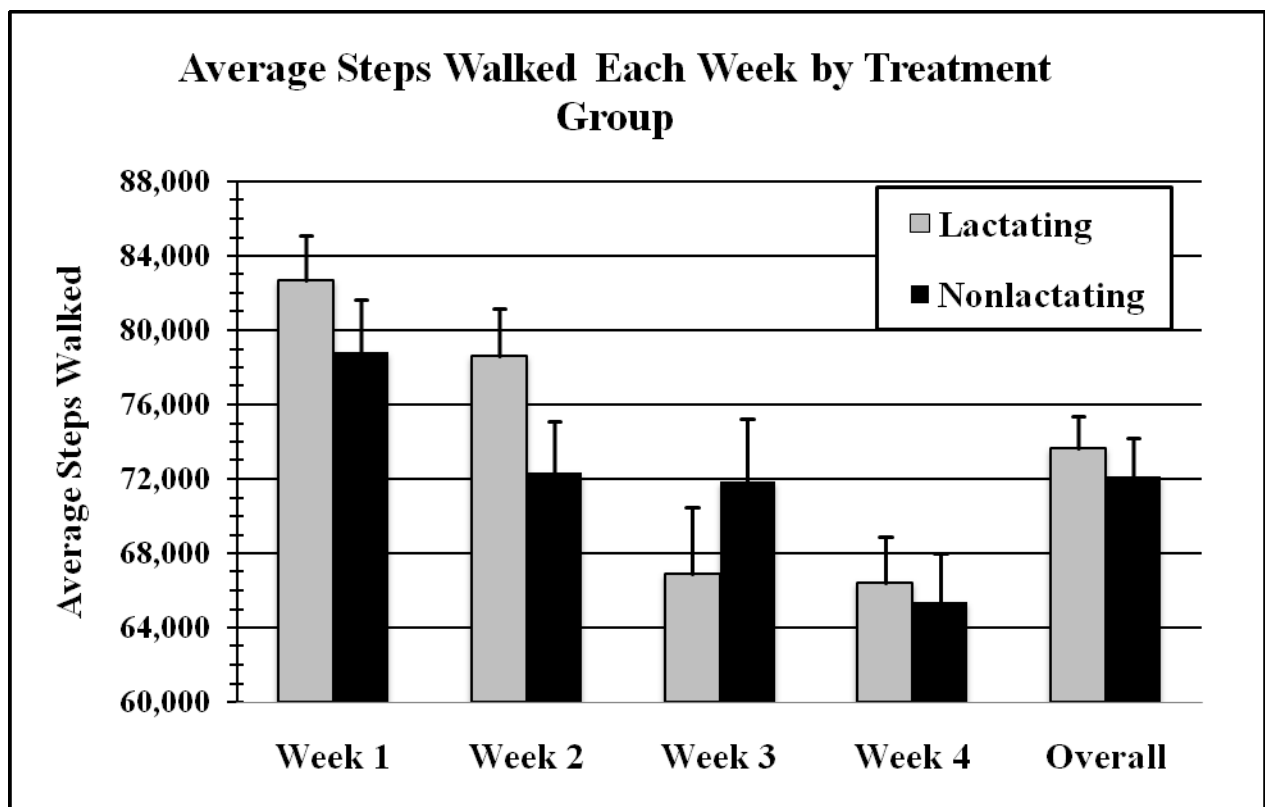
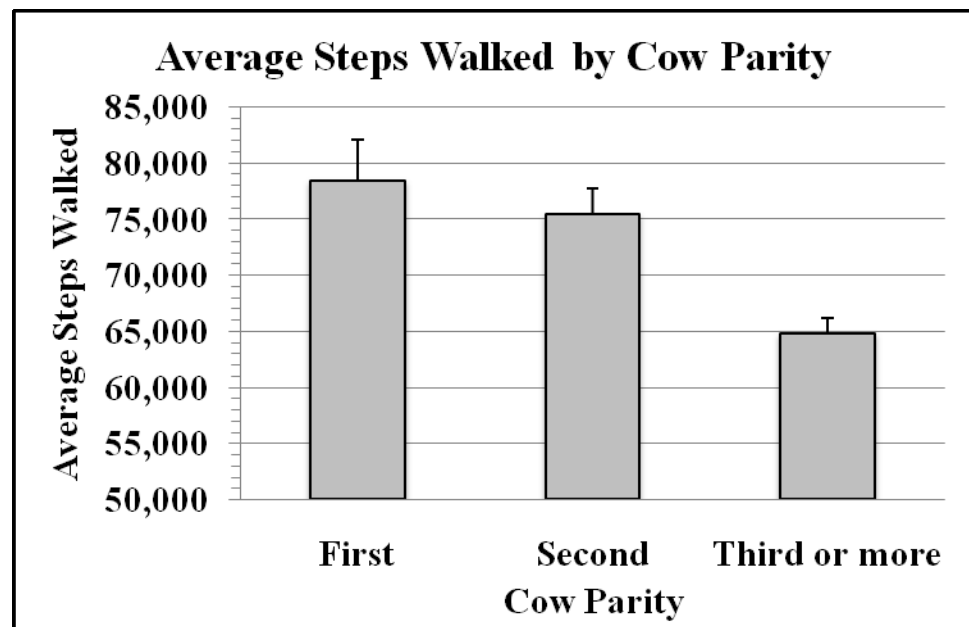


Table 1: Overall there was no statistical difference between the two treatments. There was a treatment by week interaction during the second week, indicating that a difference in forage consumption between EW and NW cows may occur.

Upon further data analysis, it was determined that age of dam had a significant effect on total steps walked. First and second parity cows on average walked significantly more ($76,944 \pm 2998$) throughout the entire duration of the study than third or greater parity cows ($64,795 \pm 1405$) regardless of the assigned treatment group ($P = .0002$). This effect can be partially explained by the fact that younger cows still require nutrients for growth. This is in addition to nutrients required for maintenance, reproduction, and lactation (for those in the NW treatment). In addition, older cows generally have more stored energy from which to withdrawal. (See Table 2 for average steps walked by parity of cow.)

Table 2: The age of the cow had a significant impact on the total number of steps taken regardless of the treatment group. Younger animals walked



Implications

Although the effect of treatments was not significant across the four weeks, the significant effect during the second week suggests that a larger scale project with more experimental units and, hence, more statistical power should be performed. The pedometers used resulted in approximately 37% of the potential measurements being lost, indicating that improvements in the devices are desirable. In addition, the validity of using pedometers as a proxy to feed consumption on pasture needs to be investigated. Future research should be done over a longer period and the frequency of the measurements should be increased. Future research should also impose a better control (balance across treatments) for age of the dams and include more cows in the study.

If later research further establishes that EW cows consume less forage when grazing on pasture than NW cows, it will become more desirable to use early weaning practices. Feed costs are an extremely variable cost associated with livestock production. Efficient pasture management can lead to a reduction in overall feed costs, potentially creating more net profit for the producer. In addition, if producers could decrease the amount of forage consumed on an individual cow basis, they could potentially have enough extra forage to add additional cows to the herd. Alternatively, with the increasing value of land, producers could reduce input costs by maintaining the same number of cows on less total acreage. Combined with improved performance of early-weaned calves and increased calf profits, these additional benefits demonstrate that an early weaning system can be a tremendous asset to the cattle producer.

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